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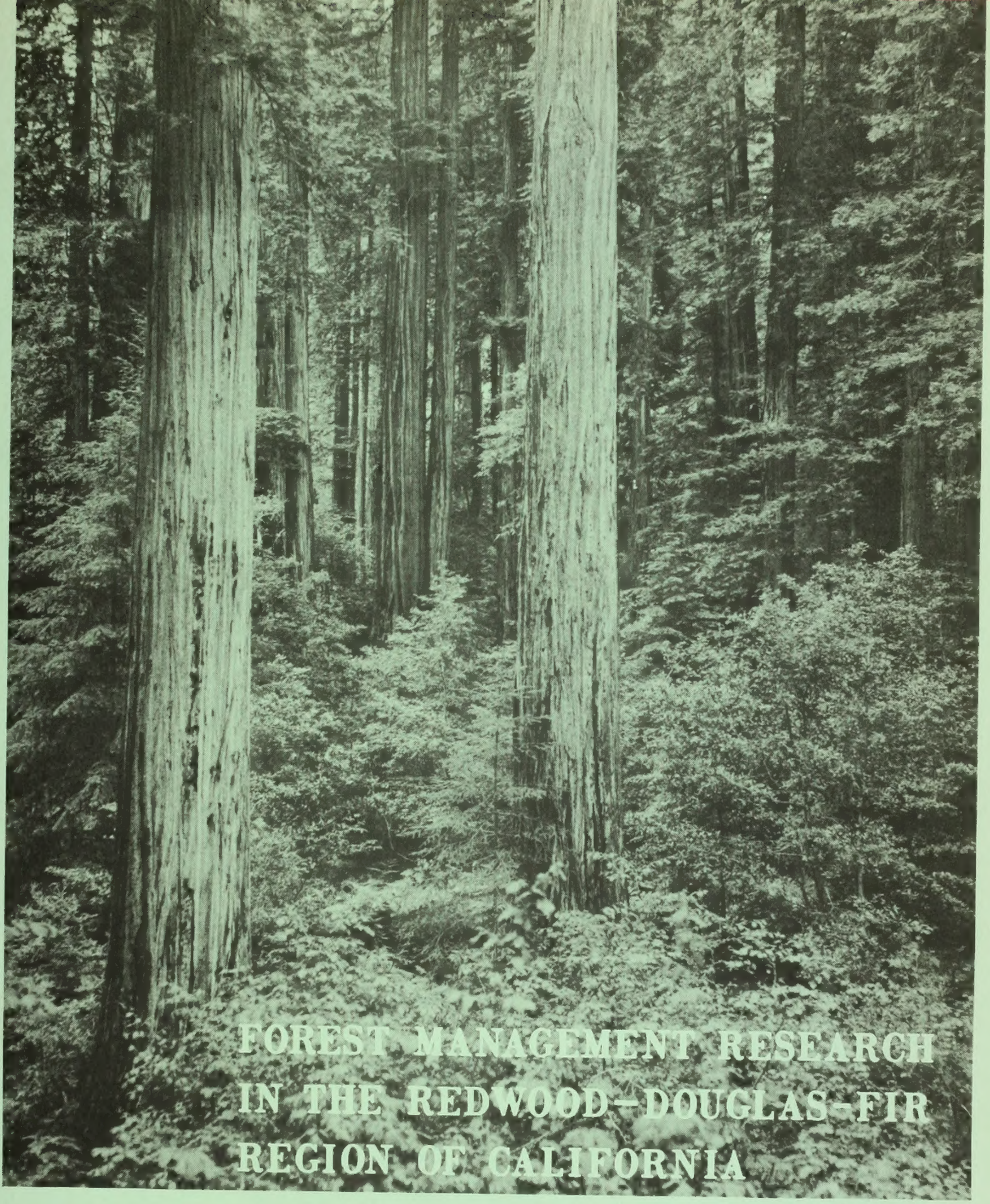

FOREST MANAGEMENT RESEARCH IN THE REDWOOD-DOUGLAS-FIR REGION OF CALIFORNIA

...a summary of foresters' views on research needs

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FOREST MANAGEMENT RESEARCH IN THE REDWOOD--DOUGLAS-FIR REGION OF CALIFORNIA--A SUMMARY OF FORESTERS' VIEWS ON RESEARCH NEEDS

By D. F. Roy, Forester,
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Miscellaneous Paper No. 24 April 1958

CALIFORNIA FOREST AND RANGE EXPERIMENT STATION
FOREST SERVICE, U.S. DEPARTMENT OF AGRICULTURE

The Experiment Station is maintained at Berkeley, California in cooperation with the University of California.

Agriculture--Forest Service, Berkeley, California

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Cover picture: A virgin redwood forest on Indian Creek, northern Mendocino County. The trees in the foreground, from left to right, are approximately 6 and 8 feet in diameter breast high, respectively. Tanoak is prominent in the understory.

FOREST MANAGEMENT RESEARCH IN THE REDWOOD--DOUGLAS-FIR REGION OF CALIFORNIA--A SUMMARY OF FORESTERS' VIEWS ON RESEARCH NEEDS

By D. F. Roy

INTRODUCTION

Two major timber types occur on the western slopes of the North Coast Ranges of California. They are the unique redwood type, which is close to the coast, and the Douglas-fir type, found farther inland. Together these two types provide the name for the area--the redwood--Douglas-fir region.

Wood products have been manufactured in the region for more than a century. Redwood has established a world-wide reputation as a superior product for a wide variety of uses. In the 12 years since 1945 Douglas-fir logging in the region has grown to nearly twice the size of the redwood harvests, and has become an integral part of the region's economy. The trend toward growing forests to replace the virgin old-growth already has begun. Foresters have made a good start in managing forest lands.

Yet despite the long history of timber production, foresters still lack many of the working tools needed for high-level land management which will obtain the maximum profit from forest land. Forest lands must be kept productive by growing new fully stocked crops of timber after the virgin growth is gone. And the natural resources--the soil, the watersheds, and the fisheries--must be protected. Foresters working for timber companies and public agencies in the redwood--Douglas-fir region need the help which research can provide.

THE FOREST RESOURCE

AREA

More than three-fourths of the land area of the redwood--Douglas-fir region (5.8 million acres) is forested. Of this, 73 percent, or 4.2 million acres is commercial forest land--land capable of growing useable crops of wood. [1] The redwood type covers 1.9 million acres; the Douglas-fir 2.0 million acres.

GROWTH POTENTIAL

Its capacity for growing wood sets the redwood--Douglas-fir region apart from others. The forests of this region are among the fastest growing of the world. On the more favorable sites both redwood and its associated species grow remarkably fast. High sites in the redwood type will grow a minimum of 600 board-feet per acre per year, and the better sites which are well-stocked with young timber will produce more than 1,000 board-feet per acre each year. Many young forests have averaged 2,000 board-feet per acre per year, and small plots as much as 3,300.

Much of the region is high site forest land. In the redwood type, 81 percent of the commercial forest land has been classed as high site quality and only 2 percent as low site. High site Douglas-fir land accounts for 53 percent of the total acreage in this type, and 10 percent is low site. For the entire region 65 percent of the commercial forest land is high site quality, 28 percent medium, and 7 percent low.

STAND CONDITIONS

By 1952 logging in the redwood--Douglas-fir forests had reached its centennial. Nevertheless, 57 percent of the commercial forests still remained in old-growth sawtimber by 1953 (table 1). Although logging has been extremely heavy since 1953, the volume of old-growth timber left is enough to supply the industry as a whole for many years.

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[1] Statistics quoted in this report are found in:

1. Forest Survey Staff. 1954. Forest statistics for California. U. S. Forest Serv., Calif. Forest and Range Expt. Sta. Forest Survey Release 25, 66 pp., illus.

2. Poli, Adon, and Baker, Harold L. 1954. Ownership and use of land in the redwood--Douglas-fir subregion of California. U. S. Forest Serv., Calif. Forest and Range Expt. Sta., Tech. Paper 7, 76 pp., illus.

3. Vaux, Henry J. 1955. Timber in Humboldt County. Calif. Agr. Expt. Sta. Bul. 748, 55 pp., illus.

Table 1.--Acreages in stand-size classes, redwood--Douglas-fir region, 1953

Stand-size class	Area	
	1,000 acres	Percent
Old-growth sawtimber	2,430	57
Young-growth sawtimber	978	23
Pole timber and seedlings and saplings	277	7
Nonstocked	553	13
All classes	4,238	100

YIELD FROM FOREST LAND

LUMBER PRODUCTION

In 1956, 54 percent of all timber products harvested in California came from the redwood--Douglas-fir region. Lumber, 86 percent of the region's wood products output, was sawn by 380 active mills and tallied 3,032 million board-feet. [2] Humboldt County produced more lumber than any other county in the state, and Mendocino County ranked second. Together these two counties accounted for 41 percent of the lumber manufactured in the state. [3]

OTHER BENEFITS

Forests of the redwood--Douglas-fir region yield more than lumber measured in board-feet. They provide jobs for mill and woods workers and for others employed in the basic industries. For example, in 1950 the wood industries provided one-third of all earnings from gainful employment in Humboldt County. And 71 percent of all jobs in the basic industries were supported by forest products.

2/ Unpublished file data, Division of Forest Economics Research, Calif. Forest and Range Expt. Sta.

3/ May, R. H. and Baker, H. L. 1957. Lumber production in California, 1956. U. S. Forest Serv., Calif. Forest and Range Expt. Sta., Forest Survey Release 30, 15 pp., illus.

Furthermore, the forests are watersheds and habitats of wildlife. Not least are the aesthetic qualities of the magnificent redwoods which attract thousands of visitors annually to groves set aside for recreation. Obviously, forests are the major asset of the redwood--Douglas-fir region.

PROBLEMS OF THE LUMBERING INDUSTRY

Despite the large volume of timber in reserve, the large acreages of high site quality land, and the phenomenal growth rates in well-stocked young stands, there has been some apprehension concerning the future. Several existing problems have been defined and others are anticipated.

GENERAL PROBLEMS

The problems facing the lumbering industry in the redwood--Douglas-fir region are varied in subject and scope. They can be divided into two categories: Forest management problems, which include the subjects of silviculture, mensuration, and regeneration; and general problems in the fields of engineering, technology, and sociology. Examples of the general problems are:

1. The financing and construction of access roads. The road system determines in part the amount of timber available to mills and the efficiency with which the remaining timber can be harvested.

2. The need to make the growing of timber crops attractive to owners of small timber tracts. These owners need guidance and advice on both legal and timber management procedures, and on effective supervision of timber sale agreements.

3. Ways to utilize more completely materials which now are left in the woods or become mill residue.

4. Determining and establishing equitable methods of taxation for forest lands.

FOREST MANAGEMENT PROBLEMS

The forest manager's job is to handle forest lands so they yield maximum returns. Any hindrance in the way of this goal is a problem.

Interviews with forest managers in the redwood--Douglas-fir region in 1955 spotlighted several specific needs to obtain better sustained yield management--the method of forest management which achieves a balance between net growth and harvest. Altogether 41 men employed by 35 organizations were interviewed. Of these 21 were professional foresters. Representatives of 17 organizations articulately expressed opinions on the needs which could be supplied by forest management research.

They listed these needs as follows (numbers in parentheses show the number of land managers citing the subject as a problem requiring research work):

1. Site Classification and Yield Tables (10)

The tool most urgently requested was a site classification showing the relative capacities of various redwood lands for growing timber. A site classification will become increasingly important as more forest lands become stocked with young-growth. To be more than superficially useful, however, a site classification must be accompanied by yield tables which show the growth that different sites can achieve. Yield tables also include information on tree sizes and the number of trees per acre at various ages. They are used to predict future timber growth. Sound business management of forests depends upon the ability to forecast growth accurately. Therefore, filling the need for a site classification accompanied by yield tables deserves high priority in the redwood--Douglas-fir region research program.

2. Management of Virgin Forests

Methods of cutting in virgin redwood stands (8).--Much mature timber is now ready for harvesting. These stands should be cut to maximize growth of residual trees and minimize logging damage. We should determine the relative advantages of clear cutting, shelterwood, and selection methods of regeneration cutting, and learn how to get the most growth and most useable material from existing forests.

Tree vigor classification for redwoods (11).--A system for classifying vigor of individual trees would solve the practical problem of selecting which trees can and should be reserved for later harvesting and which ones should be logged before they deteriorate. Proper choice of trees to leave during selection logging will produce maximum growth and minimum losses.

Windthrow (3).--Foresters want to know how to cut timber stands to eliminate or reduce the number of trees blown down after logging.

Marginal logs and chunks (2).--Loggers need help in recognizing the logs and chunks which will pay their way through the sawmill. They want to know which pieces can be utilized profitably in salvage logging.

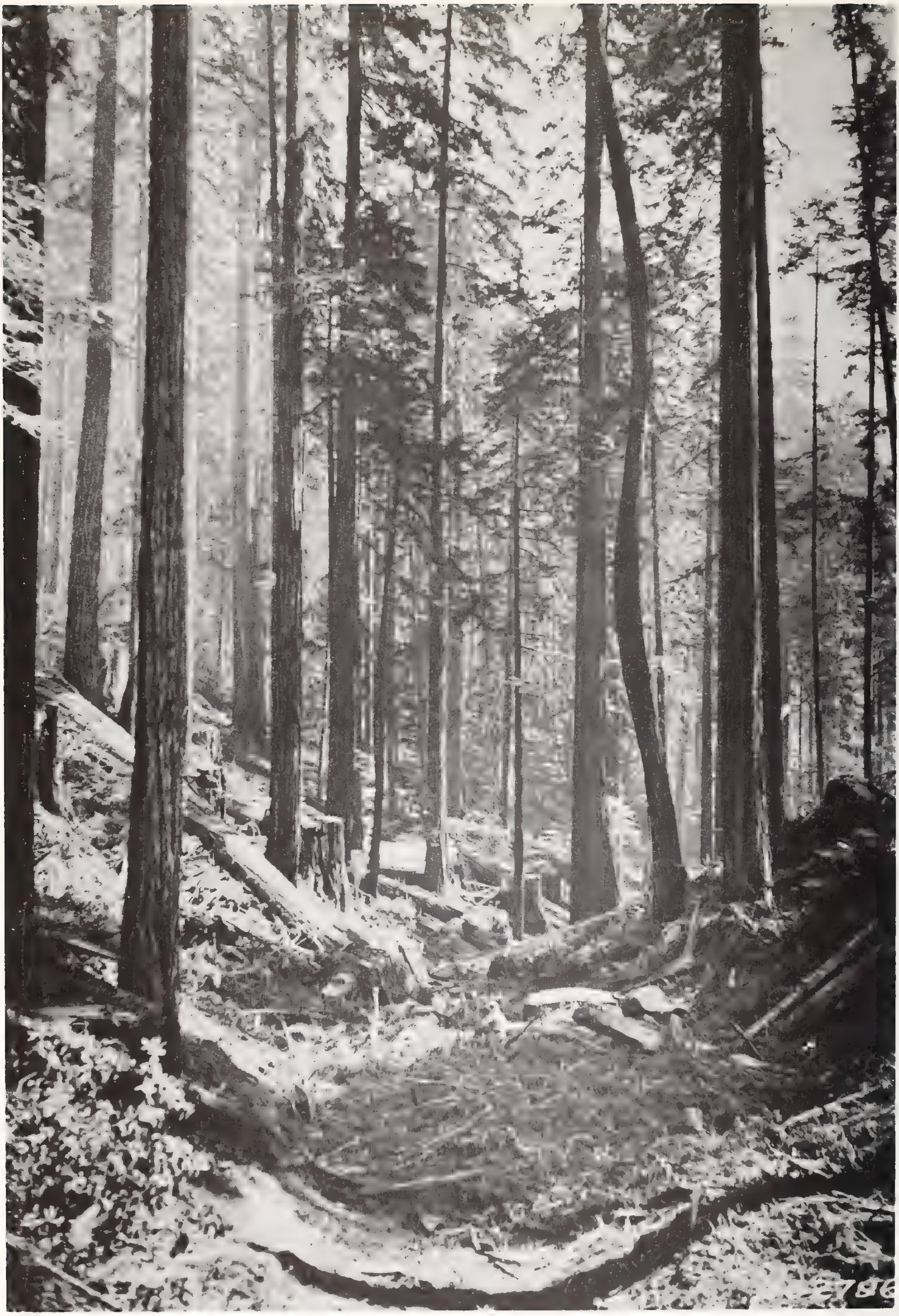

Figure 1.--Results of selection marking on Henry Creek, Humboldt County, California. The picture was taken before yarding had been completed. A tree vigor classification would help foresters choose the best trees to leave under this system of marking.

Slash disposal (3).--Logging creates enormous masses of slash which are a serious impediment to reforestation. If left, slash may prevent seedlings from growing, and it increases the fire hazard for years. If it is burned, the fire may destroy seed on the ground and kill the seed trees. What can we do with limbs, tree tops, and cull logs to reduce the hazard from fire without damaging residual timber and younger trees? Is there a relationship between the heat generated by slash burning and the value of the area as a seedbed?

3. Regeneration (8)

No one is satisfied with our present knowledge regarding renewal of a forest after logging or burning. Right now a half million acres of understocked and non-stocked forest lands are occupied by brush. What can we do to rehabilitate these idle acres? And what natural or artificial means can we use to keep other forest land productive?

Natural Regeneration (6)

Regeneration cuts in Douglas-fir stands (4).--Clear-cutting seems best suited for regeneration of Douglas-fir stands. We need guides, however, which show the relationships of natural stocking to the size, shape, and orientation of clear-cut patches.

Seed production (2).--Redwood sprouts restock some lands fairly well, but residual or border trees must produce abundant seed crops to restock cutover land completely. Unfortunately, we do not understand fully how many factors such as soil fertility, weather conditions, and insects affect seed production.

Seed protection (2).--When forest trees do produce seed, rodents and birds destroy vast quantities of it. Techniques for protection of tree seed from seed-eaters have not been completely proved, although some encouraging leads have been found.

Artificial Regeneration (7)

Classes of planting stock (2).--We have not yet defined the trees which survive best when planted on cutover or burned land. Planting sites vary. Soils may be clayey or loamy; elevations may be high or low; slopes may face the north or south; and so on. We need to know how old, how tall, and how large in diameter planting stock should be to obtain best survival, considering unit costs, on the various planting sites.

Competing vegetation (2).--How can undesired plants, such as blueblossom ceanothus along the coast and tanoak further inland, economically be prevented from competing with young conifers.

Protection from animals (3).--How can small trees be protected from damage by woodrats, porcupines, and deer? And larger young trees from bears?

4. Management of Second-growth Stands (7)

Foresters say that the management of second-growth stands to obtain maximum yield in terms of profit needs immediate study. We must know the number of trees per acre at various ages and on various sites which will grow the most volume of wood. From such information we can plan schedules to guide the thinning of stands which will maintain good growth on the choicest trees. We must learn how pruning limbs from trees increases financial returns on the final product. And the yields of forests composed of only one species must be compared to yields of forests with two or more kinds of trees. Information concerning these subjects will show how to increase profits.

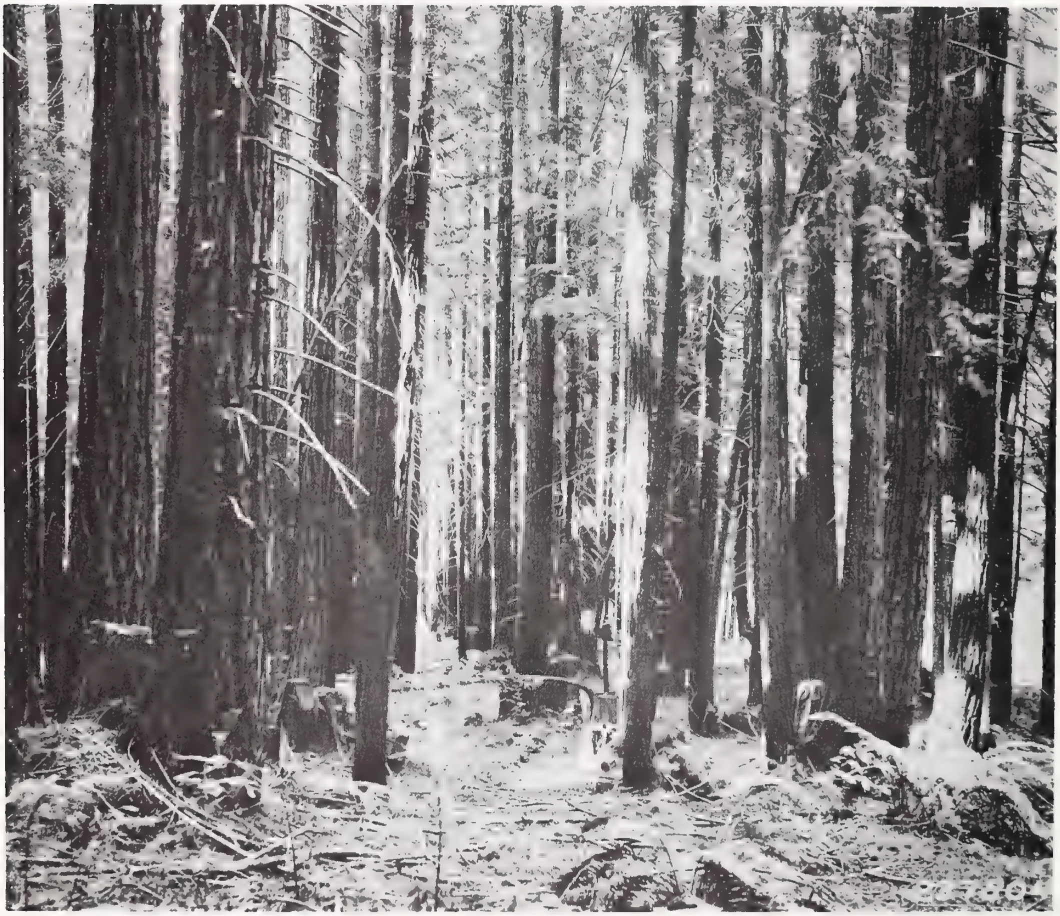

Figure 2.--A young-growth redwood stand. Most of the young trees originated from root-crown sprouts. Foresters need guidance in managing these young-growth stands to obtain maximum profits.

5. Utilization of Second-growth Redwood (4)

Management of young-growth redwood must pay its own way. Management of these stands, therefore, is intimately associated with wood utilization. Since young stands will not produce lumber grades which match the high quality material from virgin stands, ways must be found to improve and fully utilize the material which is harvested.

6. Small-scale Studies

Foresters in the redwood--Douglas-fir region also want research to investigate other subjects which are narrower in scope. Some of these are:

1. Standardization of the size and shape of growth plots and the data recorded for them. (4)
2. Revision of volume tables for redwood and Douglas-fir. (4)
3. Revision of hardwood volume tables. (1)
4. Log grading and lumber yield studies. (3)
    a. Redwood. (2)
    b. Douglas-fir. (2)
5. Improve cull indicators for redwood and Douglas-fir. (4)
6. Study scaling practices, especially the accuracy of the Humboldt scale. (4)
7. Study logging techniques to improve post-logging stream conditions. (3)

These are the outstanding problems facing the managers of redwood--Douglas-fir forest lands which can be answered by research. These problems should serve to guide an active forest management research program.

THE RESEARCH PROGRAM

PAST

In 1930 the California Forest and Range Experiment Station began a redwood research program. It continued until 1942, when staff members assigned to the project transferred to wartime duties. The program was not reactivated after the war. Although this program lasted a relatively short period, several publications which illustrate the services furnished by research were produced. Some of the subjects were:

1. Volume and taper tables for old-growth redwood.
2. Volume and taper tables for Port-Orford-cedar.
3. The effect of shade, mineral soil, and number of seed trees on natural reseeding of redwood cutover land.
4. Comparisons of the efficiency and cost of tractor, slackline, and highlead yarding, and the effect of log size and certain other factors on yarding costs for these three methods.
5. Ways to protect reserve and seed trees from redwood slash fires.
6. The growth of trees left after selective logging.
7. Results of tree planting by landowners.

Later, the Experiment Station published descriptions of cull indicators and tables of cull factors for redwood, Douglas-fir, sugar pine, ponderosa pine, white fir, red fir, and the principal hardwood species in northwestern California.

From time to time, other persons and agencies have studied problems of the region. One of the earliest substantial research projects was conducted by the University of California School of Forestry. It was a preparation of young-growth yield tables for redwood and Douglas-fir. Although the table is inadequate to supply all the growth information needed today, it has served to show the remarkable growth capability of redwood second-growth. Professor Emanuel Fritz's extensive writings concerning many subjects are also well known.

More recently Henry J. Vaux of the University of California School of Forestry prepared a bulletin on timber in Humboldt County which points out the opportunities and economic problems of maintaining timber growth. Hammon, Jensen, and Wallen, consulting foresters, have prepared up-to-date volume tables for second-growth redwood. And the Experiment Station has published form-class volume tables for second-growth redwoods and some hardwood species.

Several other studies have been reported. Their titles can be found in an annotated bibliography published by the Foundation for American Resource Management. 4/ Citations in the bibliography are indexed by authors and subjects. A shorter annotated bibliography of selected subjects on the silvical characteristics of redwood is now being prepared by the Experiment Station. And reports published before 1953 on the regeneration of Douglas-fir also have been annotated in an indexed bibliography. 5/ Though largely based on studies in other regions, the Douglas-fir reports undoubtedly have considerable application in the redwood--Douglas-fir region.

PRESENT ADMINISTRATIVE STUDIES

Several private operators, the California Division of Forestry, and the U. S. Forest Service are carrying out administrative studies. The maintenance of permanent growth plots is an example. Although most of this work is not research in the strictest sense, the records will have considerable research value. The subjects being studied are (the numbers in parentheses show the number of organizations involved):

I. Mensuration

    A. Old-growth stands

        1. Local yield tables for redwood (3)

        2. Growth studies (10)

            a. Old-growth redwood (9)
            b. Old-growth Douglas-fir (1)
            c. Residual redwoods (4)

        3. Height-diameter relationship for redwood (1)

        4. Utilized volume tables for redwood (2)

        5. Logging residue inventories (2)

4/ Fritz, Emanuel. 1957. California coast redwood (Sequoia Sempervirens (D. Don) Endl.)), an annotated bibliography to and including 1955. Foundation for American Resource Management, San Francisco, California. 267 pp.

5/ Roy, D. F. 1953. Douglas-fir regeneration, a selected and annotated bibliography for use in California. U. S. Forest Serv., Calif. Forest & Range Expt. Sta., Tech. Paper 1, 27 pp.

6. Log grading and lumber yield studies

    a. Redwood (5)
    b. Douglas-fir (2)

B. Young-growth stands

1. Growth of reserve redwood trees (2)

2. Cull percentage for young-growth redwood and Douglas-fir (1)

3. Stump diameter versus utilized volume for redwood and Douglas-fir (1)

II. Silviculture

A. Windthrow (1)

B. Stand improvement (2)

1. Thinning in redwood (2)

2. Pruning in redwood (1)

III. Regeneration

A. Natural

1. Seed dispersal (2)

B. Artificial

1. Aerial seeding in Douglas-fir (1)

2. Seed spotting (3)

    a. Redwood (2)
    b. Douglas-fir (3)

3. Planting (4)

    a. Redwood (1)
    b. Douglas-fir (4)

IV. Biological factors

A. Bear damage to young redwood stands (1)

CURRENT RESEARCH STUDIES

Current research concerning management of forest lands in the redwood--Douglas-fir region is providing some help to forest managers and to the whole forest products industry.

Douglas-fir Regeneration

Since 1952, the Experiment Station has been studying regeneration of Douglas-fir in the North Coast Range. These studies are aimed at learning how to reforest land quickly after harvesting overmature Douglas-fir. Because almost all cultural treatments are expensive, success or failure in establishing reproduction naturally is of great significance to the land manager. Hence, although we are investigating various aspects of both artificial and natural reproduction, our field studies have been concentrated on the factors influencing natural reproduction. The three major questions we are studying are:

1. How abundantly are sound seeds produced and in what patterns are seeds distributed from natural sources? By answering this question we can recommend size and arrangement of cuttings.

2. What are the ground-surface conditions after logging, particularly with regard to amount and quality of seedbeds? We want to know if adequate seedbeds are prepared by normal logging operations, or if supplementary ground preparation is necessary to obtain adequate stocking from natural seedfall.

3. How does vegetational cover develop after logging? Related questions are:

    a. How long will cutover areas remain receptive to seedfall?

    b. How long can we wait for natural regeneration before artificial methods become necessary to hold control of the ground?

    c. How much competition from broadleaf vegetation can we expect? What conditions will require special cultural treatments?

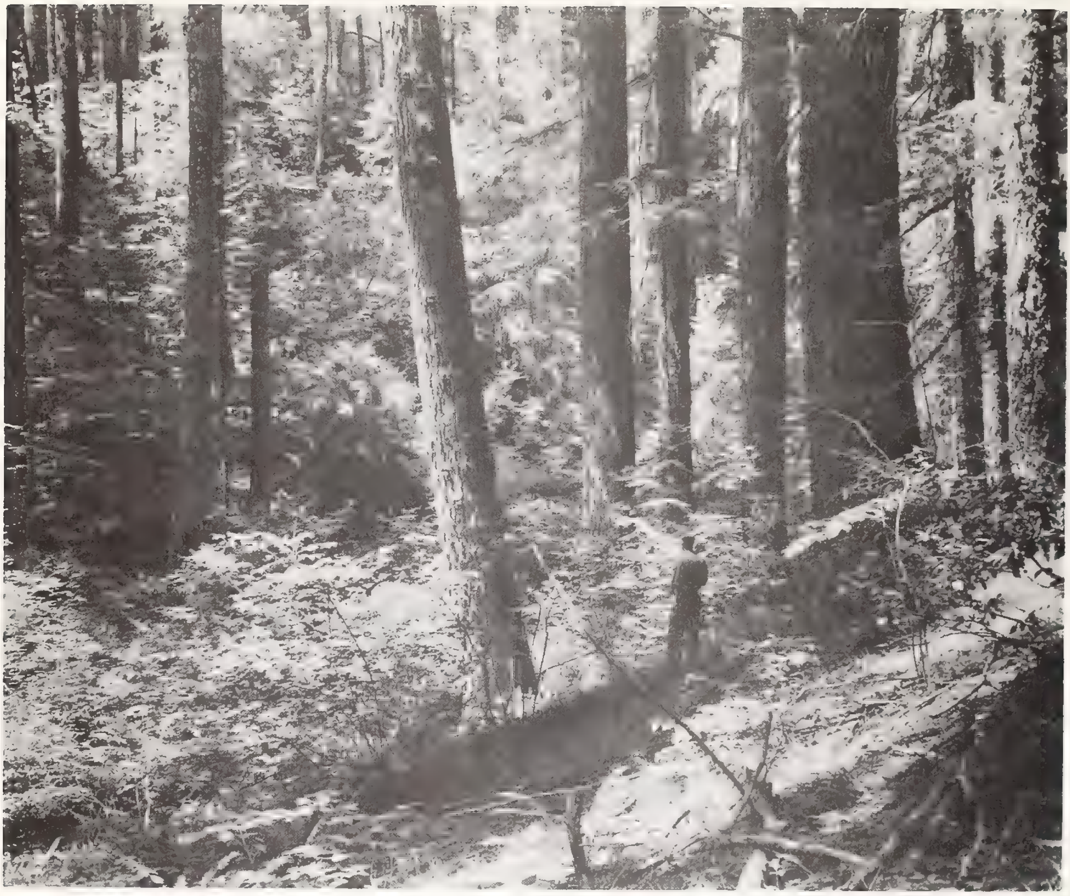

Figure 3.--Interior of an old-growth Douglas-fir stand near Willow Creek, Humboldt County, California. Understory species are tanoak, bigleaf maple, vine maple, Pacific dogwood, and Pacific yew. Regeneration studies are aimed at learning how to reforest land quickly after logging these overmature Douglas-fir stands.

Management of Old-growth Redwood

Redwood research by the Experiment Station was started in 1957, at the Yurok Redwood Experimental Forest, Del Norte County, in cooperation with the Simpson Redwood Company. The old-growth redwood stand in the High Prairie Creek drainage will serve as a field laboratory and demonstration area to:

1. Test even-aged and uneven-aged management.
2. Determine factors affecting natural regeneration and subsequent development of seedlings.
3. Compare logging costs by different intensities of cut.

4. Evaluate logging damage during initial and later cuts.

5. Determine growth of residual stands and of individual trees by age, size, and vigor classes.

6. Study the utilization of merchantable sawtimber and sound logging residue.

7. Demonstrate methods of reducing the fire hazard of logging slash without damaging reserved trees.

8. Demonstrate logging and road construction methods which will reduce erosion and undesirable stream conditions to a minimum.

Vegetation-soil Survey

Another Experiment Station activity, conducted in cooperation with the California Division of Forestry and the University of California, is the vegetation-soil survey in Mendocino and Humboldt Counties. Maps showing timber stands, other vegetation, and kinds of soil are now available for private lands in Mendocino County and the southern portion of Humboldt County. Maps for the remaining part of Humboldt County probably will be finished in 1959, and for Del Norte County by the end of 1960. These maps are useful for several purposes, one of which is to show the capability of the land for timber growth. Some other uses are: to estimate erosion hazard and to plan post-logging treatments necessary to prevent soil movement; to develop road specifications and estimate road maintenance costs; to evaluate the threat of brush encroachment after logging; and to show where soil and vegetation are similar to that on experimental areas and thus help apply results of research.

Forest Insect Studies

The Experiment Station also is studying the life history of cone and seed insects and the amount of damage they cause to Douglas-fir seed crops. The goal is to prevent seed destruction, especially during years of moderate seed production when insect damage is most significant. The Douglas-fir beetle and other insects also will be studied.

Forest Products Research

Information which may have considerable impact on management of forest land in the redwood--Douglas-fir region is being obtained by the Forest Service's Forest Products Laboratory at Madison, Wisconsin, and the University of California School of Forestry Forest Products Laboratory.

One Forest Service project is the study of pulping redwood, Douglas-fir, and tanoak. Another subject, being investigated in cooperation with the California Redwood Association, is the penetration and retention of preservatives in young-growth redwood. Results may help to develop a market for redwood poles. And recently redwood region operators have been studying and in some cases have adopted accelerated kiln schedules suggested by preliminary investigations of the Forest Products Laboratory at Madison. These improved schedules consider lumber stresses under different conditions of temperature and humidity, thereby reducing drying time and defects.

The University of California Forest Products Laboratory is engaged in several studies. Technicians are investigating the gluing characteristics of California hardwoods, end gluing of redwood and Douglas-fir, and solvent seasoning of redwood. They are also analyzing extractives of redwood, the mechanical properties of Pacific madrone and tanoak, and the drying characteristics of Pacific madrone, tanoak, and golden chinkapin. Other laboratory studies concern the effects of drying conditions on collapse and seasoning stain of redwood.

Forest Zoology Study

Zoologists from the University of California at Davis are studying the role of seed-eating rodents and birds in the destruction of Douglas-fir seed. They have affirmed the possibility of creating rodent populations which will reject conifer seed as food and have developed a technique which protects both naturally and artificially placed seed. Rodent populations and their feeding habits on severely burned forest lands also were studied.

Young-growth Redwood Yield Study

Another University of California project has been undertaken by a staff member of the School of Forestry. Relying in part on data already collected by private companies, the School of Forestry, the California Division of Forestry, and the Experiment Station, he is beginning to study the yield of young-growth redwood stands. Eventually yield tables will be compiled to show the amount and quality of wood material young redwood stands will provide at specified periods to about 100 years of age. The tables will consider the interrelations of site, stand density, species composition, and timber growth, and will reflect the standards of utilization which it now seems reasonable to obtain. An initial product, expedited by a grant-in-aid from the Foundation for American Resource Management, will be a new volume table for young-growth redwood.

STRENGTHENING THE RESEARCH PROGRAM

Research in the redwood--Douglas-fir region is seriously inadequate compared to experimental work in the more fully developed forest regions of the United States. Although a large number of subjects are being studied, the total effort amounts to only a few man-years, and progress will be slow. Land managers recognize a host of problems that need solutions. Some of the more important are not being touched--they are too big for the present work force to consider. Obviously, we need to do better.

The first step toward strengthening the research program in the redwood--Douglas-fir region is to decide what level of effort is required to produce results when needed. From ownership records we learn that the commerical timberland is divided among almost 10,000 individuals, corporations, and other commercial organizations, and a few public agencies. The public owns about one-third, mainly in national forests. Another one-third is in small private ownerships. About 15 percent of the privately owned land is in holdings of over 50,000 acres. These large holdings, primarily in redwood, include only five ownerships. Considering the complex ownership pattern, some single organization should be charged with the major responsibility of organizing a research program which would serve the interests of all owners. The Redwood--Douglas-fir Region Research Committee, recently formed under sponsorship of the Northern California Section of the Society of American Foresters could undertake this task. (The Redwood--Douglas-fir Research Committee already is planning a publication on the management of young-growth redwood stands. Compilation of this report, a cooperative venture, will be an excellent contribution.)

After planning, a forest management research program for the redwood--Douglas-fir region can be accelerated two ways. The most effective way to obtain an adequate program is to assign more full-time research men to field studies.

The second way to complement the research program is to develop cooperation among organizations. Foresters, operators, and landowners seem universally willing to cooperate but need some guidance in planning studies. Working alone, single organizations would find some studies too burdensome. Working together, the many units in the region can collect increments of research data which will answer the questions when pooled.

The richly endowed forest lands of the region are waiting. The sooner research is strengthened, the sooner forest industries will find answers to questions facing them today and will solve the production problems of tomorrow. Increasing productivity through research will expand the economy of the Redwood--Douglas-fir region.